The Development and Validation of the Clinicians' Attitudes Towards the Impact of Cognitive Errors (CATChES) In Clinical Decision Making Questionnaire Tool

By

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LIST OF ABBREVIATIONS

CATChES	Clinician's Attitude Toward the impact of the Cognitive Errors
HUSM	Hospital Universiti Sains Malaysia
EFA	Exploratory Factor Analysis
i-CVI	Item level Content Validity Index
κ*	Modified Kappa
CITC	Corrected Item Total Correlation
SMC	Square Multiple Correlation
Pc	Probability of chance agreement

LIST OF APPENDICES

Menghasilkan dan Menjalankan Proses Pengesahan (Validity) Soalan Kajian Mengenai Sikap Pegawai Perubatan Klinikal Terhadap Kesilapan Kognitif (CATChES) di Dalam Membuat Keputusan Klinikal.

Abstrak

Pengenalan

Meskipun terdapat kesan buruk keatas ketepatan mendiagnosis penyakit, masih terdapat kekurangan kepada kajian terutama alat soal selidik untuk menilai sikap pegawai perubatan klinikal terhadap kesilapan kognitif. Satu proses pengesahan (validity) dilakukan untuk menghasilkan soalan kajian mengenai sikap pegawai perubatan klinikal terhadap kesilapan kognitif (CATChES) di dalam menentukan keputusan klinikal.

Kaedah

Soalan ini dibahagikan kepada dua bahagian; Bahagian A untuk menilai sikap pegawai perubatan klinikal terhadap kesilapan kognitif di dalam menentukan keputusan klinikal manakala bahagian B bertujuan menilai sikap pegawai perubatan klinikal terhadap kesilapan kognitif yang tertentu. Pengesahan Konstruk "Construct validity" menggunakan ujian exploratory factor analysis (EFA) dilakukan kapada bahagian A. Manakala untuk bahagian B, pengesahan isi-kandungan "content validation" menggunakan indeks 'item level content validity' (i-CVI) dan pengubahsuaian kappa "modified kappa" (κ*) dilakukan.

Keputusan

Ujian EFA pada bahagian A menunjukkan model dua faktor dengan jumlah varians terhasil adalah 60%. Dua item telah dikenalpasti bermasalah dan di keluarkan. Ujian EFA di ulang dan didapati kesemua "factor loading" berada diatas dari nilai yang ditetapkan 0.5. "Cronbach's alpha" untuk kedua dua faktor adalah lebih dari 0.6.

Malakala bahagian B, pengesahan isi-kandungan boleh diterima dengan nilai i-CVI adalah 0.89 dan keatas. Pengubahsuaian kappa menunjukan nilai 0.89 dan keatas untuk kesemua item dan di terjemahkan sebagai cemerlang.

Kesimpulan

Alat soal selidik CATChES merupakan soalan yang disahkan untuk menilai sikap diantara pegawai perubatan klinikal terhadap kesilapan kognitif dalam menentukan keputusan klinikal.

(BILANGAN PATAH PERKATAAN: 244 PATAH PERKATAAN)

Katakunci:

Validity, Reliability, kesilapan kognitif, Menentukan keputusan klinikal, Exploratory factor analysis

The Development and Validation of the Clinicians' Attitudes Towards the Impact of Cognitive Errors (CATChES) In Clinical Decision Making Questionnaire Tool

Abstract

Introduction

Despite their impact on diagnostic accuracy, there is a paucity of literature on questionnaire tool to assess the clinicians' attitudes toward cognitive errors. A validation was study conducted to develop a questionnaire tool to evaluate the ***C***linician's ***A***ttitude ***T***owards the impact of ***C***ognitive ***E***rror***s*** (CATChES) in clinical decision making.

Methods

This questionnaire is divided into two parts; Part A is to evaluate the clinicians' attitude towards cognitive errors in clinical decision making while Part B is to evaluate their attitude towards specific cognitive errors. For Part A, construct validation using exploratory factor analysis (EFA) was performed. For Part B, content validation using item level content validity index (i-CVI) and modified kappa (κ*) was performed.

Results

For EFA of Part A shows a two-factor model with total variance extraction of 60%. Two items were deleted. The EFA was then repeated with all factor loadings above the cut-off value of >0.5. The Cronbach's alphas for both factors were above 0.6.

For Part B, the content validity is acceptable with values of i-CVI of 0.89 and above in terms of their relevance. Modified kappa was shown to be 0.89 and above for all items and rated as “excellent”.

Conclusion

The CATChES questionnaire tool is a valid questionnaire tool to evaluate the attitude among clinicians toward cognitive errors in clinical decision making.

(WORD COUNT: 216 words)

Keywords:

Validity, Reliability, Cognitive Errors, Clinical decision making, Exploratory factor analysis

MANUSCRIPT

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The Development and Validation of the Clinicians' Attitudes Towards the Impact of Cognitive Errors In Clinical Decision Making Questionnaire Tool

Introduction

Ranging from between around 10 – 15% (Berner and Graber, 2008), diagnostic errors are often shown to be due to multiple factors (Graber *et al.*, 2005; Kohn *et al.*, 2000). Out of these factors, cognitive errors have been recognized as a major source (Croskerry, 2003). Cognitive errors are our predictable deviations from rationality and may derail the clinicians from diagnostic accuracy if left unchecked (Croskerry *et al.*, 2013). Although they may believe otherwise, clinicians are in fact, just as prone to commit cognitive errors as anyone else (Bornstein and Emler, 2001; Klein, 2005).

In a survey by MacDonald involving 6400 clinicians regarding their concerns and opinions on diagnostic errors, 51% of them conceded that they experienced diagnostic errors at least a few times in the last one year while another 44% said that they experienced diagnostic errors on a weekly or monthly basis (MacDonald, 2011). When asked further on what they thought were the factors contributing to diagnostic errors, the top three reasons cited by these clinicians have cognitive components: 75% of them cited atypical patient presentation (resulting in the doctors being misled to consider other diagnoses), 50% cited failure to consider other diagnoses while 40% cited gathering inadequate patient history as one of the reasons (MacDonald, 2011).

As pointed out by Prochaska *et al.* (1992) in their Transtheoretical Model of Change, the first step towards behavioral change is known as contemplation. In the context of cognitive errors in clinical decision making, this is the stage where a clinician becomes acutely aware of the negative impact of cognitive errors on diagnostic accuracy as well as factors that increase the vulnerability of a clinician in committing such biases in clinical decision making. On the other hand, a person who is unaware of the problem sees no reason to take any action to change. This prior stage is known as the pre-contemplation stage (Prochaska *et al.*, 1992). On the other hand, once a clinician is in the contemplation stage, he or she sees the necessity to initiate steps towards the intended behavioral change (in this case, minimizing the risk of committing cognitive errors when making clinical decisions). This subsequent stage of initiating steps towards change is known as the preparation stage (Prochaska *et al.*, 1992).

Although numerous cognitive errors have been described, Campbell *et al.* (2007) have classified the clinically important cognitive errors into six categories. These categories are (1) errors due to over-attachment to a particular diagnosis (examples of cognitive biases in this class include anchoring and confirmation bias), (2) errors due to failure to consider alternative diagnoses (for example, search satisficing), (3) errors due to inheriting someone else's thinking (for example, diagnostic momentum and framing effect), (4) errors in prevalence perception or estimation (for example, availability bias, gambler's fallacy and posterior probability error), (5) errors involving patient characteristics or presentation context (for example, cognitive biases: fundamental attribution error, gender bias), and (6) errors that are associated with the doctor's affect or personality (for example, visceral bias and sunk cost fallacy) (Campbell *et al.*, 2007).

Yet, despite the impact of cognitive errors on diagnostic accuracy, there is a paucity of literature on questionnaire tool to assess the clinicians' attitudes toward cognitive errors. This paper describes the

validation process of a questionnaire aimed to evaluate the attitude of clinicians working in emergency department towards the impact of cognitive errors in clinical decision-making.

Methods

Participants

The emergency medicine residents or clinicians with a minimum of four years' working experience in Hospital Universiti Sains Malaysia were chosen as the participants for the exploratory factor analysis. Using the rule of thumb of a minimum of five participants per item, a minimum of 30 participants is required. Clinicians who were not residents pursuing a postgraduate degree in emergency medicine or clinicians with less than four years of working experience in the emergency department were excluded.

For content validity evaluation in Part B, based on the recommendation by Lynn (1986), ten experts were invited to determine the content validation. These experts were the lecturers and emergency physicians of Hospital Universiti Sains Malaysia.

Materials

For Part A, the Transtheoretical Model of Change (Prochaska *et al.*, 1992) was used to develop a preliminary version of this questionnaire. Six items were generated in this preliminary version. The theoretical basis for each of the items is given in Table 1.

For Part B, the classification of cognitive errors by Campbell *et al.* (2007) was used to generate the preliminary list of categories of cognitive errors. Each category of the cognitive errors is defined as an item. A total of six items were generated.

Procedure

This was a cross-sectional study conducted among clinician in Hospital Universiti Sains Malaysia (HUSM). Convenient sampling was applied in recruiting the participants. Human Research Ethics approval was obtained from The Human Research Ethics Committee of the Universiti Sains Malaysia before the study was commenced. (Reference: USM/JEPeM/15010015)

The questionnaire used in the present study is divided into two parts. The first part of the questionnaire is to evaluate the attitude of clinicians toward cognitive errors in clinical decision making (Part A) while the second part is to evaluate the clinician's attitude towards specific cognitive errors in clinical setting (Part B).

For the construct validation of Part A of the questionnaire, after obtaining consent, the participants were first briefed on how to respond to the items ranked in a Likert scale of five, ranging from "1 = strongly disagree" to "5 = strongly agree". Participants were told to respond anonymously and that they were free to opt out at any time. A separate document on the glossaries of terms were handed out and read to the participants prior to starting the questionnaire. All participants responded individually in one sitting.

For the content validation of Part B of the questionnaire, after obtaining consent, the expert panels were identified and approached individually by the first author. The expert panels were briefed on

how to respond to the relevance of the items, ranked in a Likert scale of four, ranging from "1 = not relevant at all" to "4 = highly relevant". The experts were told to respond anonymously and that they were free to withdraw from the study at any time. The response sheets were left to the experts to respond on their own and were collected back by author AH the following day. The document on the glossaries of terms were handed out and read out to the participants prior to starting the questionnaire.

Statistical analyses

For Part A, Exploratory factor analysis (EFA) was used to determine the construct validity of Part A of the questionnaire. Principal axis factoring was chosen as the extraction method. The initial run of the factor analysis was performed to determine the number of items to be extracted. An eigenvalue of more than 1 was chosen as the cut-off value to determine whether the numbers of factors to be fixed. Scree plotting was also performed to further verify the number of factors for extraction. Repeated runs of the factor analysis were then performed to determine the factor loadings of the items as well as to identify problematic items that may need to be removed. A cut-off point of 0.5 was used as the criteria in factor loading to determine whether an item is to be removed or not (Hair *et al.*, 2006). Whereas for communality (extraction), a value of >0.25 was set as the cut-off value to determine the need for item removal (Hair *et al.*, 2006). Promax oblique rotation was used. The internal consistency reliability of the item was determined by analyzing the Cronbach's alpha coefficients. Cronbach's alpha refers to the degree to which participants' responses are consistent across the items within this questionnaire construct (Cho and Kim, 2014). A cut-off point of Cronbach's alpha >0.6 was set for this study for the criteria of a good degree of internal consistency (Cho and Kim, 2014; Zhang *et al.*, 2010).

To evaluate the content validity in terms of the relevance of these items in Part B, the content validity index (i-CVI) and the modified kappa were used. The i-CVI for relevance is defined as the proportion of the judges who rate the item with scores of 3 or 4 on a four-point Likert scale (with 1 =

not relevant at all, 2 = somewhat relevant, 3 = quite relevant, and 4 = highly relevant) (Lynn, 1986). i-CVI value of 0.85 and above to be considered as valid (Lynn, 1986). To account for the possibility of chance agreement in i-CVI (Polit *et al.*, 2007), the modified kappa (κ) was computed as well.

Results

With regards to the construct validation using EFA on Part A, generally the Kaiser-Mayer-Olkin measure of sampling adequacy was found to be 0.74 which shows that there is a moderate degree of common variance shared among the items. The Bartlett's test of sphericity was statistically significant (with chi-square statistics = 43.93, $p < 0.05$). This shows that there are correlations among the items based on the correlation matrix. Initial eigenvalue indicates that the first two factors (which has the eigenvalue >1) explain 60% of the total variance (42% and 18% respectively). Furthermore, 2 factors were shown to be above the point of inflexion of eigenvalue on the scree plot (Figure 1). Therefore, the number of factors was fixed at 2 for re-run of the analysis.

After 2 rounds of test re-run, two items out of the six were removed as they did not meet the minimum cut-off points of factor loading >0.5, and communality values of >0.25. In particular, item no. 3 *("Authority gradient discourage critical thinking and thus increase the vulnerability to commit cognitive errors")* was recognized as problematic with factor loadings of only 0.14 and 0.20 in both factors and its communality value (extraction) of 0.084 only. Item no. 4 *("Something, rather than nothing, can be done to minimize the risk of falling into these errors")* was also identified as problematic with factor loading of 0.481 in Factor 2 and a communality (extraction) value of 0.145.

After removal of the two items, the re-run of the principal axis analysis of the remaining 4 items shows that they explain 75% of the variance with two factors extracted. All items in this analysis had factor loadings of >0.5 and communalities (extraction) of >0.25. The pattern matrix of the factor

loading is presented in Table 2. Item no. 1 *("Cognitive errors in general have important impact towards clinical decision making in emergency medicine"*) and item no. 2 *("Being aware of cognitive errors help me to be more careful in my clinical decisions"*) load on Factor 2 whereas item no. 5 *("The understanding of cognitive errors and its impact on clinical decision making and patient safety should be made a component in emergency medicine curriculum in postgraduate training")* and item no. 6 *("The understanding of cognitive errors and its impact on clinical decision making and patient safety should be taught at undergraduate level")* load on Factor 1. Hence, we labeled factor 1 as the "educational interventions to reduce the risk of cognitive errors" whereas Factor 2 is labeled as the "impact of cognitive errors in clinical decision making".

Both factors yield a Cronbach's alpha of 0.676 and 0.635 respectively and no further improvement in the Cronbach's alpha values could be achieved by deleting any of the items.

With regards to the content validity of Part B of the questionnaire, the i-CVI values for all items were rated highly as valid in terms of their relevance in clinical settings. In terms of the values of their modified kappa (κ*), all items were rated as "excellent" in terms of the validity of their relevance in clinical settings. In the finalized version of the CATChES questionnaire (Table 4), the sequence of the factors is reversed, with Factor 2 placed first before Factor 1.

Discussion

From the EFA, Part A of the questionnaire is constructed with two factors, viz., the "impact of cognitive errors in clinical decision making" and "educational interventions to reduce the risk of cognitive errors". Each of these two factors has two items. Referring back to the Transtheoretical Model of Change by Prochaska *et al.* (1992), Factor 2 "impact of cognitive biases in clinical decision

making" reflects the contemplation stage of the model, where as Factor 1 "educational interventions to reduce the risk of cognitive biases" reflects the preparation stage of the model.

Furthermore, from the EFA, it is also shown that there are two items that had to be removed. For item no. 4 *("Something, rather than nothing, can be done to minimize the risk of falling into these biases")*, the phrase 'something, rather than nothing' is rather ambiguous and this may result in its rejection by the participants as a valid item. Re-phrasing with a more direct sentence may bring greater clarity. For example, it could be rephrased, as 'Specific de-biasing strategies are effective in minimizing the risk of committing cognitive biases.

For item no. 3 *("Authority gradient discourages critical thinking and thus increase the vulnerability to commit cognitive errors")*, its rejection could be due to the fact that the statement is overly generalized, particularly in an Asian culture. Authority gradient is defined as the gradient that may exist between two individuals' professional status, experience, or expertise that contributes to gap in exchanging information or communicating concerns. In our study, perhaps our participants did not think that authority gradient is always bad. Nurtured in an environment where a healthy level of authority gradient is respected, a senior, experienced clinician can train a junior clinician in inculcating better clinical decision making skill.

In terms of the internal consistency analysis of Part A, a moderate degree of internal consistency measured by both Cronbach's alpha values of more than 0.6 in both factors was noted.

Based on the content validity evaluation of Part B of the questionnaire, all items (categories of cognitive biases) were retained as they were shown to have excellent validity in terms of their relevance in clinical setting.

There are a number of limitations in this validation study. First, for Part A, a repeat EFA as well as confirmatory factor analysis was not performed after the two items were removed. Second, face validity was not performed to determine its comprehensibility and readability. For example, as mentioned, the phrase 'something, rather than nothing' in item no. 4 is rather vague. The future development of this project would include rewording and rephrasing the items as well as repeating the EFA as well as confirmatory factor analysis to devise the second edition of this questionnaire.

Conclusion

Despite its limitation, based on the construct and content validation, the CATChES questionnaire tool is shown to be a valid psychometric tool to evaluate the attitude and perception among clinicians toward cognitive errors in clinical decision making. Knowing their attitude would determine their awareness of the impact of these cognitive errors as well as their motivation to take measures to minimize risk of committing these errors.

(WORD COUNT: 2379 words)

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Table 1 Preliminary list of items to evaluate the attitude of clinicians toward cognitive errors in clinical decision making

Item	Rationale of this item
Item no. 1 *"Cognitive errors in general have important impact towards clinical decision making in emergency medicine"*	This item is aimed to evaluate whether the clinician has any awareness towards the impact of cognitive errors in clinical decision making. Is the clinician in precontemplation stage or contemplation stage?
Item no. 2 *"Being aware of cognitive errors help me to be more careful in my clinical decisions"*	This item is aimed to evaluate whether the clinician believe that realize that by just being aware of these cognitive errors would improve the quality of his clinical decisions.
Item no. 3 *"Authority gradient discourage critical thinking and thus increase the vulnerability to commit cognitive errors"*	Authority gradient is defined as the gradient that exists between two individuals of different professional status, experience, or expertise that contributes to difficulty in exchanging information (Cosby and Croskerry, 2004). This item is aimed to assess the clinician's perception on whether he or she believes that authority gradient discourages critical thinking on cognitive errors toward clinical decision
Item no. 4 *"Something, rather than nothing, can be done to minimize the risk of falling into these errors"*	To assess the motivation of the clinician towards change by minimizing the impact of cognitive errors in clinical decision making

Item no. 5 *"The understanding of cognitive errors and its impact on clinical decision making and patient safety should be made a component in emergency medicine curriculum in postgraduate training"*	To assess the motivation of the clinician towards change by minimizing the impact of cognitive errors in clinical decision making
Item no. 6 "*The understanding of cognitive errors and its impact on clinical decision making and patient safety should be taught at undergraduate level"*	To assess the motivation of the clinician towards change by minimizing the impact of cognitive errors in clinical decision making

Table 2 Pattern Matrix of the Factor Loadings

	Factor	
	1 "Educational interventions to reduce the risk of cognitive errors"	2 "Impact of cognitive errors in clinical decision making"
Item no. 1 *"Cognitive errors in general have important impact towards clinical decision making in emergency medicine"*		0.616
Item no. 2 *"Being aware of cognitive errors help me to be more careful in my clinical decisions"*		0.590
Item no. 5 *"The understanding of cognitive errors and its impact on clinical decision making and patient safety should be made a component in emergency medicine curriculum in postgraduate training"*	0.668	
Item no. 6 "*The understanding of cognitive errors and its impact on clinical decision making and patient safety should be taught at undergraduate level"*	0.601	

Note:

1. Principal Axis Factoring was used as the extraction method
2. Promax oblique rotation with Kaiser normalization was used as the rotation method
3. Values of factor loading <0.5 are suppressed and not displayed

Table 3 Content Validity of Item Relevance for Part B of Questionnaire

Item	N	A	P_C	I-CVI	κ*	Evaluation of κ
Item no. 1 *"Cognitive errors due to over-attachment to a particular diagnosis"*	9	9	0.00195	1	1	Excellent
Item no. 2 *"Cognitive errors due to failure to consider alternative diagnoses"*	9	9	0.00195	1	1	Excellent
Item no. 3 *"Cognitive errors due to inheriting someone else's thinking"*	9	9	0.00195	1	1	Excellent
Item no. 4 *"Cognitive errors in prevalence perception or estimation"*	9	8	0.01757	0.89	0.89	Excellent
Item no. 5 *"Cognitive errors involving patient characteristics or presentation context"*	9	9	0.00195	1	1	Excellent
Item no. 6 *"Cognitive errors that are associated with the doctor's affect or personality"*	9	9	0.00195	1	1	Excellent

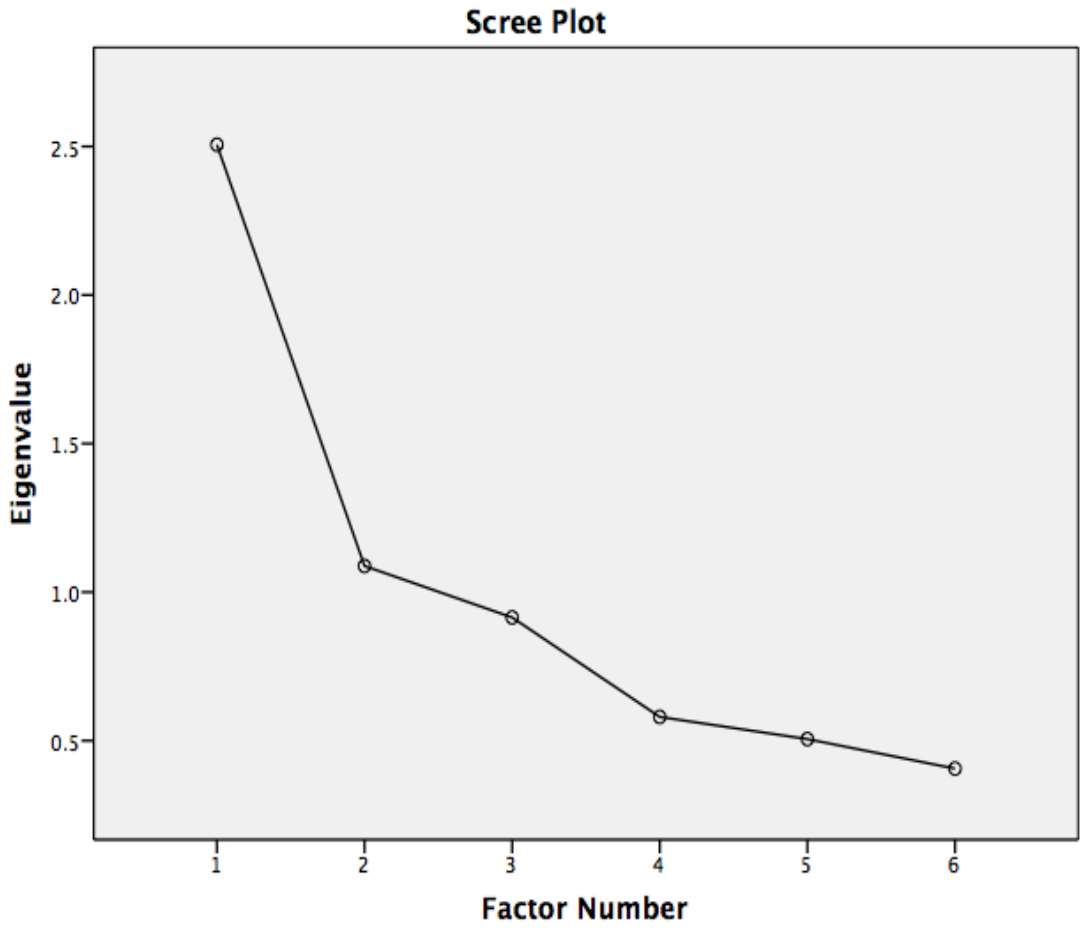
Note:

- The formula for modified kappa statistic (κ*) = (CVI-Relevance – pc)/(1 – pc), where pc represents probability of a chance occurrence (Polit *et al.*, 2007)
- P_c is the probability of chance of occurrence. The formula for pc is: $N!/[A!*(N-A)!]*0.5^N$ where N = the number of judges, A = the number agreeing on good relevance
- Evaluation criteria for modified kappa (κ*): κ = fair (0.40 – 0.59), κ = good (0.60 – 0.74) and κ = excellent (>0.74)
- CVI should be 0.85 and above (Lynn, 1986) to establish validity with a $p<0.05$

Table 4 The Final Version of the CATChES Questionnaire

Part A For this part, evaluate your response using the Likert scale where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree	
Items	**Likert scale**
Impact of cognitive errors in clinical decision making	
Cognitive errors in general have important impact towards clinical decision making in emergency medicine	1 2 3 4 5
Being aware of cognitive errors help me to be more careful in my clinical decisions	1 2 3 4 5
Educational interventions to reduce the risk of cognitive errors	
The understanding of cognitive errors and its impact on clinical decision making and patient safety should be made a component in emergency medicine curriculum in postgraduate training	1 2 3 4 5
The understanding of cognitive errors and its impact on clinical decision making and patient safety should be taught in undergraduate level	1 2 3 4 5
Part B **For this part, state whether the following categories of cognitive errors are relevant in your clinical practice**	
Cognitive errors due to over-attachment to a particular diagnosis	**Relevant** / **Not relevant**
Cognitive errors due to failure to consider alternative diagnoses	**Relevant** / **Not relevant**
Cognitive errors due to inheriting someone else's thinking	**Relevant** / **Not relevant**
Cognitive errors in prevalence perception or estimation	**Relevant** / **Not relevant**
Cognitive errors involving patient characteristics or presentation context	**Relevant** / **Not relevant**
Cognitive errors that are associated with the doctor's affect or personality	**Relevant** / **Not relevant**

Figure 1. Scree Plot (6 item)



Appendix A

RESEARCH HYPOTHESIS AND OBJECTIVES

3.1 Research Hypothesis

A set of questionnaire can be validated as a tool for assessment of attitude towards cognitive error in clinical decision-making among postgraduate students in emergency medicine at HUSM.

3.2 General research objective

To developed and validate a set of questionnaire to assess attitude toward cognitive error in clinical decision-making among postgraduate students in emergency medicine.

3.3 Specific objectives

a. To developed a set of questionnaire regarding altitude toward cognitive error in clinical decision making and demonstrating validity using Content Validation Index

b. To demonstrating construct validity of the questionnaire using exploratory factor analysis

c. To demonstrating reliability of the questionnaire using Cronbach's alpha.

Appendix B

METHODOLOGY

Study Design and Duration

This study was an observational cross-sectional self-reported study of a six months period from june 2014 until December 2014. The primary endpoint of the study was to validate a tool to assess attitude and perception toward cognitive error in clinical decision-making thus lead to diagnostic error.

Study Location

This study was conducted at Emergency Department, Hospital Universiti Sains Malaysia (HUSM), Kubang Kerian, Kelantan.

Selection of Subjects

The reference populations were emergency doctors working in the Emergency Department, Hospital Universiti Sains Malaysia. The source populations were Emergency Medicine postgraduate student of Universiti Sains Malaysia. The eligible populations were the source population fulfilling the inclusion and exclusion criteria.

Inclusion criteria

1. Postgraduate students in emergency medicine at HUSM
2. Candidate who attended lecture on cognitive thinking
3. Consented for the study

Exclusion criteria

1. Candidate who refuse to involve in the study

2. Incomplete or empty form

Expert reviewers are Emergency Physician who is completed training and gazette with working experience as an Emergency Physician for at least 3 years.

Mode of data collection

All entitled subjects who fulfilled the inclusion criteria were included in the study and were explained thoroughly regarding the study. Information on the study and consent forms (Appendix E) were distributed to the subjects. All entitled subjects were given time to make decision regarding to the willingness to participate on the study. The subjects then attended a lecture on critical thinking in clinical decision-making presented by a senior lecturer in emergency medicine that is familiar with this topic. Questionnaire and related article were given to each of the subject for further reference if needed.

Expert reviewers were taken among Emergency Physicians who worked in Emergency Department for at least 10 years and expert in emergency case for at least 3 years. Nine Emergency Physician participated and were given explanations and related articles regarding cognitive biases.

No specific sampling calculation is employed, as all eligible subjects working in emergency department HUSM will be included in the study. Convenient sampling applied.

Appendix C

Data Analysis

All the data were analyzed with Statistical Package for Social Sciences (SPSS) software version 22.0. The researcher generated initial questionnaire components based upon discussion and the literature findings, and circulated drafts to the expert panel for several rounds of revision to refine wording and content. This step is important to ensure face validation as well as content validation.

To answer the objective of this study, the data were analyzed in the following methods:

Objective 1

Content validation index (CVI) will be used to quantifying content validity for likert scale base on expert judgment on the degree of relevancy and representativeness. CVI value will be computed for each item on a scale (which refer to as I-CVI) with value of lower than 0.78 would be considered candidates for reversion and those very low values would be candidates for deletion.

Modified kappa (κ*) was computed using the proportion of agreement on relevance and the probability of chance agreement:

$$\kappa * = \frac{I - CVI - Pc}{1 - Pc}$$

Evaluation criteria for kappa, using guidelines described in Cicchetti and Sparrow (1981) and Fleiss (1981): Fair = κ of .40 to .59; Good = κ of .60 to .74; and Excellent = κ >.74

Probability of chance agreement (*Pc*):

$$Pc = \left[\frac{N!}{A!\,(N - A)!}\right].5^N$$

N =Number of experts and A=Number agreeing on good relevance.

Objective 2

We will use Exploratory Factor Analysis (EFA) to demonstrate construct validity. Oblique method (Promax) is used for Rotation of factor (factor are assumed to correlate) because this questionnaire measured same construct. Principal axis factoring is used for Extraction method (Common Factor Model), as it does not assume normally distributed data.

Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (indicates the degree of common variance among the item) value of more than 0.7 will be taken as significant – indicates that there is common factor among the item. Bartlet's test of sphericity with *P*-value of less than 0.05 will be taken as significant and indicates worthwhile correlation among the items based of correlation matrix.

For determination of number of factors, Eigenvalues of more than 1 will be used. The cut-off value is 1 because if extracted factor is worth less than what a single variable can explain, the factor is not worthwhile to be extracted. Scree plot also will be use to determined number of factor.

Item will be removed accordingly base on Communalities (Extraction), Pattern matrix (pattern coefficients), and Factor correlations. Communalities value of more than 0.25 will be take as acceptable value of variance explained by the extracted factors. Factor loading of more than 0.5 and Factor correlations of less than 0.85 will be use for all items in construct.